National Aeronautics and Space Administration
Glenn Research Center
Cleveland, Ohio

John Glenn
Biomedical Engineering Consortium
Helping Astronauts, Healing People on Earth

Keeping a Beat on the Heart

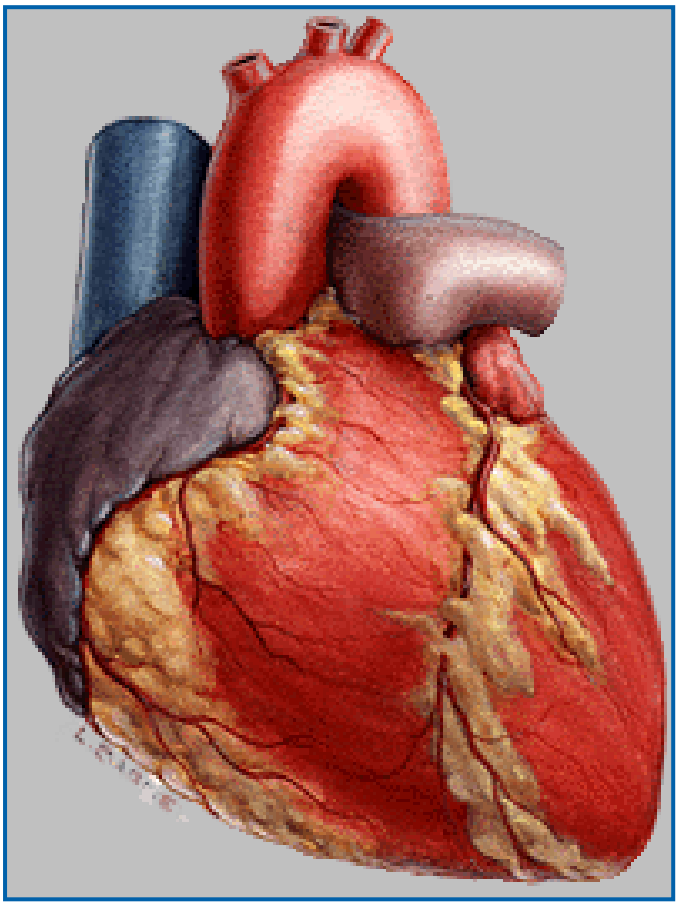
This research aims to detect and diagnose any astronaut dysrhythmias both onboard spacecraft and from Earth. The novel, secure communications system will require only a Web browser to access the data. The same system will be adaptable for use on Earth to provide an early warning for the thousands of people with arrhythmia.

Over 300,000 Americans die every year of "sudden heart attacks." These deaths are attributable to electrical malfunctions of the heart known as cardiac dysrhythmias and arrhythmias. Of course, cardiac dysrhythmias are a major health risk to astronauts as well. Several cases of dysrhythmias have already occurred in space.

Through the John Glenn Biomedical Engineering Consortium (GBEC), principal investigator David York of Glenn Research Center and co-investigator David Rosenbaum of Case Western Reserve University, MetroHealth Systems are developing an early warning system for cardiac dysrhythmias by continuous monitoring of heart function. If NASA could adapt such a system for use in space, the risks could be reduced of an astronaut losing consciousness during critical operations or even dying in space for lack of proper care.

Researchers will be testing the hypothesis that astronaut dysrhythmias can be successfully detected, diagnosed, and treated both on spacecraft and remotely from Earth. The latest technology in electrocardiogram (ECG) sensors will be used to monitor heart function, noninvasively or with an implantable device. Data from the sensors will be transmitted to a small, wearable server that will use wireless communications to transmit ECG data to a NASA server. New wireless technologies have the advantages of low power consumption and high bandwidth, allowing a battery-driven wearable server to transfer a considerable amount of high-rate data.

ECG data will be processed by running software algorithms that analyze and examine the patterns for serious heart dysfunctions. Doctors would use advances in arrhythmia detection and diagnoses to detect and/or predict episodes that could cause harm to an astronaut, other crewmembers, or the mission.



The information gathered from the ECG's and the derived information from detection and diagnosis software will be displayed graphically in near real time using a Web browser. Spacecraft crews would also have access to preventative and reactive treatment strategies, which will probably include current Earth-based treatments such as anti-arrhythmic drugs and defibrillation.

NASA Glenn's award-winning Embedded Web Technology (EWT) program will be used to manage the database, which allows clients, using nothing more than a standard Web browser, to access data

from and provide commands to a main server. A very advantageous feature of this consortium project is that other GBEC investigators will be able to use the same main server for their own projects, with the addition of their own "personality modules." EWT enables embedded, real-time systems to act as information servers, transmitting data and receiving commands from remote clients.

Astronauts would be able to plug a laptop computer into the main server to give commands and retrieve data for each experiment. Likewise, the main server is designed to interface directly with the International Space Station communications system, which would eventually allow ground-based workstations to access each main server experiment as if the ground-based workstation were the astronaut's laptop.

Benefits on Earth

This unique project will demonstrate that, with a standard Web browser, access to near real-time ECG data, detection of dysrhythmia patterns, and diagnoses are possible both locally and remotely. It will be directly applicable to the design of an Earth-based prototype system for the public. Such a system would allow arrhythmia patients to be monitored in near real time outside the hospital. This approach benefits the hospitals by freeing resources and benefits the patients by allowing them to resume normal activities while being monitored continuously.

A ground-based unit would alert a central monitoring station by cell phone or pager if a patient is experiencing, or is about to experience, a life-threatening event. Such a system could potentially save many lives each year.

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